

6. IWC Whale Survey: submitted by Steve Reilly (Leg I), Deborah Thiele (Leg I), Paula Olson (Leg I), James Cotton (Leg I), Simon Berrow (Leg I), and Amy Williams (Leg I).

6.1 Objectives: The International Whaling Commission (IWC) and its Scientific Committee have recognized for a number of years that basic understanding of the feeding ecology of Antarctic baleen whales is important. The IWC's relatively recent interest in the effects of environmental change on whale stocks has provided a new focus for research to investigate the relationships among cetaceans, their prey and their environment. Although previous surveys for cetaceans have been conducted in the Southern Ocean, a concurrent large-scale whale and krill survey had not been conducted in the Antarctic since the development of modern acoustic tools for continuously measuring krill. During Leg I, the IWC participated in its first collaborative survey effort with CCAMLR. IWC whale observation teams participated in CCAMLR's synoptic krill survey of the South Atlantic sector of the Southern Ocean. The primary objective was to collect visual line transect data on the region's cetaceans while CCAMLR scientists sampled zooplankton continuously during daylight hours.

6.2 Methods and Accomplishments: The US-chartered R/V *Yuzhmorgeologiya* was able to berth six IWC observers, the UK *RRS James Clark Ross* was able to berth four, and the Japanese R/V *Kaiyo Maru* accommodated two IWC observers. Because the krill survey vessels were able to accommodate differing numbers of observers, it was necessary to implement different observation schedules and types of secondary data collection. Data collection was based on line-transect methods and two modes of surveying for cetaceans were used: Primary (single observation team) mode and BT (two independent teams) mode. It was not possible to collect BT mode data on the R/V *Kaiyo Maru* with only two observers present, so all effort on that ship was in primary mode. Environmental data that might affect the probability of detecting whales were recorded during all searching effort. These included weather, sea state and visibility data as judged by the observers and also data from the ship's underway instrumentation. Weather conditions were considered unsuitable for surveying if the wind speed was stronger than Beaufort force 6 or visibility was less than one nautical mile. Binoculars were used to search for cetaceans.

Cetacean Passive Acoustic Survey.

On the *RRS James Clark Ross* only, passive acoustic data were collected to complement the visual data. The acoustics project leader and operator of the acoustic equipment was also a member of the visual observation team, and therefore the acoustic data collection had to be fully automated with only minimum maintenance.

Acoustic monitoring provides an opportunity to collect data in conditions such as darkness, poor visibility or high sea states- all of which are unsuitable for visual observations. Many cetacean species are highly vocal and sound propagates well in the sea, enabling passive acoustics to be used to detect many species. The main limiting factor to detecting whales acoustically from a moving vessel is the noise from the vessel. The *RRS James Clark Ross* is particularly suitable for this kind of work because the ship was designed to be as quiet as possible. Nevertheless, the vessel was still the dominant source of low frequency noise and high pass filters were employed to reduce levels below 200Hz. This precluded monitoring for baleen whales. The acoustic

survey was aimed at odontocete whales whose vocal behavior included sounds in the 200Hz-20kHz range. Acoustic methods are particularly appropriate for sperm whale population assessment, a difficult species to survey visually because of their long dive cycles.

The equipment used consisted of a hydrophone array towed behind the ship and an automated recording and monitoring system. The array was towed on a 400m kelvar-reinforced cable and consisted of a 10m long, 30mm diameter, oil-filled, polyurethane tube containing two Benthos AQ-4 elements, 3m apart. Each AQ-4 element had a separate pre-amplifier with 29dB gain and a bandwidth of 200Hz to 40kHz. The complete array and cable configuration was calibrated after the cruise. Previous tests using the same pre-amplifier design, but different oil and tube wall material, gave a flat response with a sensitivity of $-170\text{dB re } 1\text{V}/\mu\text{Pa}$ at 20kHz. The array was streamed from the stern of the vessel at speeds of up to 12 knots and recovered using a deck winch.

The recording system used a standard Digital Audio Tape (DAT) recorder controlled by a personal computer to make 30 second recordings every two minutes. All recordings were made in stereo and the time between signals arriving at each element was used to calculate bearings relative to the axis of the array. Some of the recordings were listened to during the cruise but the majority will be analyzed following the cruise. In addition, real time monitoring software (*Rainbow Click* developed by Dr. Douglas Gillespie) designed to detect and measure bearings to sperm whale clicks was run continuously whenever the hydrophone was deployed.

Similar equipment has been used on previous studies from similar vessels in the Southern Ocean (Gillespie, 1997; Leaper and Scheidat, 1998), including from the *RRS James Clark Ross* as part of the BAS Core Programme (Leaper and Papastavrou, 1999).

6.3 IWC-CCAMLR Summaries: The associations suggested between cetacean distributions and environmental patterns are very qualitative first impressions and require a more thorough quantitative examination, as the full set of data from the cruise becomes available. The quantitative analyses that should be most interesting will be comparisons of contemporaneously collected whale sightings and krill acoustic results. The analyses will be conducted most effectively in a workshop mode with participation of both IWC and CCAMLR scientists.

The field collaboration between the IWC/SC and SC-CCAMLR was a clear success. This effort demonstrated the feasibility of expanding the scope of CCAMLR's krill surveys to include systematic surveys for cetaceans. IWC was generally successful in conducting standardized "passing mode" sighting surveys from the CCAMLR vessels. The passive acoustic survey on the *James Clark Ross* appears to have provided useful survey information on presence of odontocetes, particularly sperm whales.

The IWC will realize at least two categories of benefits as detailed data analyses are completed. First, it will have for the first time a depiction of contemporaneous but large-scale associations between baleen whales and krill in the Southern Ocean. This will fill an important gap in IWC's attempts to establish baseline patterns from which to judge potential effects of climate change on whale stocks. It is clear that if such effects occur it will be through the whales habitat and prey.

Results of this cruise will make an important contribution to the required quantification of whale habitat and prey use patterns. Second, the addition of over 10,000 km line transect searching in Areas I and II (defined by IWC) will add substantially to our general base of knowledge of whale abundance and distribution in this region. CCAMLR will realize the benefit of quantitative measures of the distribution and abundance of baleen whales, abundant and effective krill predators, as that Commission assembles ecosystem-based krill management advice.

6.4 Disposition of Data: The sightings data are on file at the IWC Secretariat in Cambridge, UK. It is suggested that the data managers from IWC and CCAMLR establish contact to initiate transfer of respectively held data sets from this cruise so that both commissions have complete sets.

6.5 References:

- Gillespie, D. 1997. An acoustic survey for sperm whales in the Southern Ocean sanctuary conducted from the RSV *Aurora Australis*. *Report of the International Whaling Commission* 47: 897-907.
- Leaper, R. and Papastavrou, V. 1999. Results for a passive acoustic survey, and visual observations of cetaceans in the Southern Ocean Sanctuary around South Georgia, conducted from the British Antarctic Survey vessel *RRS James Clark Ross*. Unpublished report to the International Whaling Commission. SC/51/O17.
- Leaper, R. and Scheidat, M. 1998. An acoustic survey for cetaceans in the Southern Ocean Sanctuary conducted from the German government research vessel *Polarstern*. *Report of the International Whaling Commission* 48: 431-437.
- Siegal, V., Kawaguchi, S., Litvinov, F., Loeb, V. and Watkins, J. 2000. Krill distribution patterns in the Atlantic sector of the Antarctic during the CCAMLR Survey 2000. Working paper submitted to CCAMLR's Working Group on Ecosystem Monitoring and Management, June 2000. WG-EMM-00/6.